

COMBAT RATION NETWORK FOR TECHNOLOGY IMPLEMENTATION

Final Technical Report STP#2001

Support and Technology Transfer

Results and Accomplishments (March 2002 – June 2009)

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1 Results and Accomplishments

1.1 Introduction and Background

This project provided support and technology transfer assistance to the Defense Logistics Agency's CORANET program in Combat Rations by the staff members of the Food Manufacturing Technology Facility. The staff members have significant amount of "know-how" in the area of combat ration manufacturing and assembly based on work that has been performed in the past under the DLA ManTech program. Often these projects have ended before the implementation by the Industry has been completed. This project facilitates the continuation of technology transfer and assist DLA and the Industry to modernize their operations and increase the manufacturability of various rations

1.2 Objectives

To provide a variety of resources and knowledgeable people in support of the objectives of the program. The Program Manager will identify or designate individual tasks or efforts to be conducted, to facilitate implementation of new technology by combat ration producers.

1.3 Results and Conclusions

FMTF Staff members have interacted with the Government, Industry and Academic Partners in and beyond the CORANET II program and maintained a high level of cooperation and rapport. They are seen as expert engineering resources that have extensive "know-how" in the manufacturing and assembly of rations. Assistance ranged from technology transfer of new developed processes under short term projects, upgrading existing systems, improving manufacturability, analyzing production systems, optimizing processes, reviewing new technology and maintaining an information database system for technology transfer.

2 Program Management

The project was awarded on March 1, 2002, under SPO103-02-D-0024, delivery order 0002, with a total obligation \$109,360. Performance period for this delivery order was initially set at 12 months through February 28, 2003. The objective of the project was to provide a variety of resources and knowledgeable people to support this program. The Program Manager would identify or designate individual tasks or efforts to be conducted, to facilitate implementation of new technology by combat ration producers. To be useful to the industry, FMTF staff members would interact with the Government, Industry and Academic Partners in and beyond the CORANET II Program, and maintain a high level of cooperation and rapport.

The following modifications were issued:

- 0002/01
- 0002/02 2/11/03 No cost extension from February 28, 2003 thru November 30, 2003
- 0002/03 5/22/03 Incremental Funding in the amount of \$15,000, increasing total obligation to \$124,360
- 0002/04 11/25/03 Extending the performance period to June 30, 2004 and adding incremental funding in the amount of \$12,000, increasing the total obligation to \$136,360
- 0002/05 1/12/04 Change of accounting data listed in block #12
- 0002/06 6/9/04 Extending the performance period to December 30, 2005 and adding incremental funding in the amount of \$50,000, increasing the total obligation to \$186,360
- 0002/07 11/1/04 Deobligated \$4,021, decreasing total obligation to \$182,339

- 0002/08 12/20/04 No cost extension to June 30, 2005
- 0002/09 1/28/05 Incremental Funding in the amount of \$54,243, increasing total obligation to \$236,582
- 0002/10 6/13/05 No cost extension to December 31, 2005
- 0002/11 8/5/05 Incremental funding in the amount of \$39,618 in support of UGA project work, increasing the total obligation to \$276,200
- 0002/12 12/19/05 No cost extension to June 30, 2006
- 0002/13 6/30/06 No cost extension to June 29, 2007
- 0002/14 9/22/06 Incremental Funding in the amount of \$25,000, increasing total obligation to \$301,200
- 0002/15 6/20/07 No cost extension to June 30, 2008
- 0002/16 3/13/08 Incremental Funding in the amount of \$25,000, increasing total obligation to \$326,200
- 0002/17
- 0002/18 6/10/08 No cost extension to December 31, 2008
- 0002/19 12/15/08 No cost extension to June 30, 2009

3 Short Term Project Activities

3.1 Process Action Teams and Industry Forums

CAFT/FMT Staff participated in Combat Ration Process Action Teams for the MRE and Heat and Serve Ration. They also attended and provided technical presentations and exhibits at Industry Forums such as the Research and Development Association, Joint Industry Government Quality Forums, Institute for Process Specialists Conferences, Defense Manufacturing Conferences and Equipment Shows such as the PackExpo

3.2 Technology Transfer

CAFT/FMT Staff provided technology and knowledge transfer in terms of improvements to readiness and other application benefits, to support the Industrial Base Preparedness program at DSCP as well as other DLA organizations. Addressing surge requirements versus production capacity has been a frequent topic of discussion in which the expert knowledge of the CAFT/FMT staff was used as an expert engineering resource.

The CAFT/FMT staff also has kept up with new technology development and on occasion visited other facilities that had the capability to demonstrate these technologies and made assessments if this technology was near ready for deployment in the ration system. For example a visit was made to PTI in Tuckahoe, New York to review advances in airborne ultrasound based systems for seal inspection and to Convertec on Corona based systems for leak detection.

3.3 Food Manufacturing Technology Demonstration

The CAFT/FMT facility was used during this period to demonstrate, simulate and validate system improvements and train personnel from combat ration producers.

For example, assistance was given to University of Georgia to scale their Egg process up from the lab scale to plant scale. Production procedures were developed and used that are mimic procedures used in large scale production systems and process conditions were determined that comply with regulatory requirements. Product samples made at the Demo Facility were statistically similar to product made at the UGA lab. For more details on this project see appendix.

Assistance was given to Texas A&M in the development and evaluation of new rack materials by exposing it to stresses normally found in an industrial retort application and then evaluating the effects on the rack material.

Frequent assistance was given by the Demonstration Facility to packaging companies that are developing new/improved packaging materials for the military and civilian industry and are in need to stress the laminates in a retort environment. A direct result of these efforts was the qualification of additional sources for the military Institutional Pouch.

The Demonstration facility was also used by combat ration producers to get training in the operation of the GFE retort control system and to study the effects of retort counter pressure on the overall performance on container integrity. The Demo facility has unique knowledge in this area and can determine in minimum time the optimal pressure profile that should be used in a retort process that will minimize container stresses.

3.4 Ration Producer Assist

The CAFT/FMT Staff provided assistance to individual ration producers while they are installing new features on line in their enterprise, and gather resulting data for evaluation and further improvements.

For example, assistance was given to ration producers in evaluating the performance of the Multiple Unit Leak Detector and in validating the non destructive seal tester for polymeric trays as a follow on of STP#2016 which had ended. Similar support was given to one of the producers that needed to evaluate non-destructively the residual gas in a large quantity of polymeric trays. A system, developed under STP#2002, was slightly modified for this purpose and send to the producer to successfully rework their production lots.

Support was also provided to modify the retort rack for the polymeric tray in order to accommodate the use of this rack in spray retorts. This was then followed by supporting efforts at Texas A&M to evaluate different rack materials.

When the surge for Iraqi Freedom occurred, support was given to ration producers in support of surge. Retorts were deployed and support given during the startup of these retorts. Retort racks were made available from the Demo Site inventory to one producer to avoid production delays due to rack lead times. Similar, the Tiromat Horizontal Form Fill and Seal equipment was deployed to a producer of baked goods, in order to increase its capacity until it had received additional equipment. Training and assistance was provided to the producers on an as needed basis and within the guidelines of the project that requires that assistance is of general nature and not private consultation.

3.5 Technical Reports and Publications

The CAFT/FMT Staff disseminated Research and Development, Science and Engineering Technology through technical reports and working papers made available via the web. Reports are used to summarize specific efforts, mini projects or other significant tasks. The CAFT/FMT Staff maintained a web based server that makes monthly, quarterly and final reports available to other Partners as well as presentations and other relevant information. The web site's address is:

<http://www.coranet2.org/>

Hard copies of these reports were made available as requested.

4 Appendix

4.1 Egg Processing Report

Egg Processing Report

1/31/06

1 CORANET Demo Site Process and Packaging Equipment

1.1 The CORANET Demonstration Site

The CORANET Demonstration Facility is located at the Rutgers University Food Manufacturing Technology Facility at 120 New England Avenue in Piscataway, New Jersey. The facility is equipped with commercial packaging lines (Tiromat for MRE's, Fresco GL-90 for institutional pouches and Raque Heat Sealer for polymeric trays) along with product preparation equipment and retort equipment, enabling it to demonstrate full scale production of Combat Rations.

The CORANET Demonstration Site was used to produce an Egg based products in MRE's. The objectives of these test runs are outlined in section 2.1. The test runs were executed in coordination with Dr Romeo Toledo from the University of Georgia. Product preparation was done in the 50 Gal Lee Kettle which has double motion scrape surface agitator and high shear mixer. The MRE pouches were sealed on the Tiromat Horizontal Form Fill Seal packaging line. The product was retorted using the Rutgers R&D Retort (single cage 1100) using water cascading as the heating mode. The thermal process was determined in cooperation with a Process Authority based on temperature distribution and heat penetration studies. The thermal process consisted of a manufacturing step that preheats the product from 40 F to 180 F, followed by a sterilization process that processes the product to a Lethality of $F_{250} > 6$ minutes. The product was tested for critical factors product viscosity, residual gas, net weight and pouch seal strength. Several samples were also incubated for 10 days at 95 F +/- 5 F. The product passed all tests and was released as commercial sterile and shipped to the University of Georgia and the Natick Soldiers Center

As the CORANET Demonstration Site, Rutgers facility is open to the Combat Ration Producers to observe and participate in production runs of Egg based products should such be found to improve the quality of the Combat Ration.

1.2 Equipment

1.2.1 High Shear Mixer.

The Demo Facility supplied a high shear mixer (Dynamic) with a 2.5 in. impeller powered by a variable speed 800 Watt motor. This hand held mixer was used to blend the various ingredients as premixes.

1.2.2 High Shear Mixing Kettle

The FMT Facility recently installed a Lee Tri-mix, Turbo Shear, 50 gal jacketed kettle. This mixing kettle has a high shear mixer for difficult to mix /ingredients. It is also equipped with a double motion agitator to gently blend ingredients that do not require shear. Both mixers can also be used simultaneously. The jacket is hooked up to both steam and cold water.

1.2.3 Tiromat Horizontal Form Fill Seal

The Tiromat, model 3000, forms and seals six MRE pouches per index. Pouches were sealed under a vacuum to control the residual gas level in the pouch.

1.2.4 Stock Retort - R&D

The FMT facility has a Stock 1100 single cage, multi heating mode, R&D retort. The retort can hold a single retort crate that can contain up to 522 MRE pouches. This retort was used for the egg project in a water-cascade heating mode in a none rotating mode. Extensive temperature distribution studies were performed to improve the uniformity of heat applied to each pouch. The retort configuration used for the production run used a shower head to distribute the heating media more evenly and additional space in between the pouch racks to ensure adequate heating media channels in between the pouches. The resulting temperature distribution was according to our process authority acceptable and comparable to production spray retorts.

2 Egg

2.1 Objective:

- To develop and test product preparation procedures for the egg blend using mixing procedures that were available with the existing Demo facility equipment
- Develop commercial sterilization process for Rutgers single cage water cascading retort
- Manufacture adequate samples for consumer testing at both the University of Georgia and the Natick's Soldiers Center

2.2 Product and Preparation Description

2.2.1 Formulation

The composite UGA-Tennessee Egg Formula was used for the experiments and manufacturing process. All ingredients were acquired by the Demo facility. The formula differed from the formula used in October 2004. At the recommendation of the University of Georgia, the Vegetone color was replaced with Yellow #5. All mixing was performed using existing equipment of the Demo facility. A test batch was made on November 8, 2005, using preparation procedures that required the pre-hydration of the Xanthan Gum before adding it to the Batch of Egg. The viscosity of this premix is however very viscous and difficult to disperse in the final mix. The mixing procedures were slightly changed for the production batch in which the Xanthan Gum was added directly to the batch kettle

Liquid Egg	606	73.5	73.51%	209.5	lb
Water	100	21.5	21.50%	61.3	lb
Liquid Margarine	607	2.94	2.94%	8.4	lb
Salt	70	0.49	0.49%	634	gram
Citric Acid	280	0.15	0.15%	194	gram
Egg Flavor	608	0.5	0.50%	646	gram
Xanthan Gum	612	0.345	0.35%	446	gram
Starch, Ultrasperse	609	0.28	0.28%	362	gram
Calcium Caseinate	610	0.28	0.28%	362	gram
Color (FD&C Yellow #5)	654	0.0012	0.00%	1.55	gram
		99.9862	100.0%	285	lbs

2.2.2 Preparation Procedures for Lot #6031, January 31, 2006

- Combine 150 ml water with color = Premix #1
- Add 15.3 lbs of the water to bucket and a small amount of margarine, then add calcium caseinate, while mixing with hand held high shear mixer. After all caseinate is added mix for 1 additional minute. (if foaming occurs add additional liquid margarine). Premix #2
- Add 46 lbs of the water and 120 lbs of the eggs to kettle and turn on scrape surface mixer and high shear mixer. Add slowly starch followed by xanthan gum.
- Add the rest of whole eggs (90 lbs) to kettle, while mixing
- Purge kettle headspace with CO₂
- Add salt and citric acid, while mixing
- Add Premix #2 while mixing.
- Add Premix #1 (color solution), liquid margarine and egg flavor to kettle while mixing.
- Mix for 25 minutes. Take 1 Gal samples at the 15 min, 20 min and 25 min mixing interval
- Transfer product to buckets for use in Filler or store in refrigerator if not immediately used

2.2.3 Product QC Data

Batch for Lot #6031, produced on January 31, 2006

pH: 6.37
Viscosity: 2465 cP @ 38 F(Brookfield model DV-I, spindle #3, 20 rpm)
Density: 0.95 gr/cc
Micro Test: Salmonella: Negative

2.3 Packaging Description

All pouches were packed off under vacuum using the Reycon Sealer for Thermocouple pouches and the Tiromat for production pouches. Top (tri) and Bottom (quad) Web Material for these pouches was supplied by Lawson Mardon

2.3.1 MRE Packaging Data 1/31/06

Fill weight MRE pouches: 8.2 oz fill weight for production

Sealing conditions Tiromat

Seal Temp: 215 C F,

Seal Time: 1.0 sec

Pouch Depth: 1.0 inch

Vacuum Time: 1.25 sec (~18" Hg)

2.3.2 Retort Data

One production retort run was made on January 31, 2006.

2.3.2.1 Retort Conditions: Lot 6031

This retort cycle was for MRE pouches, processed in the R&D Retort at 267 F in cascading mode. The retort process conditions were determined by a Process Authority to achieve minimal product lethality $F_{250} > 6$ min

Step	1	2	3	4	5	6	7	8
Phase	HSV	Flood	S2	S2	S3	C1	C2	DRN
SV Temp [C]	38							
PV Temp [C]			100	130.6	130.6			
Temp Grad [C/min]			8	5	0			
Press [bar]	0.5	0.5	1.0	2.8	2.8	2.8	1.25	
Phase Time [mm:ss]		00:39	19:30	08:30	12:30	10:00	10:00	3:00
Acc Time		00:39	20:09	28:39	41:09	51:09	1:01:09	1:04:09

Initial Product Temperature [F]:	60
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2.3.3 Quality Assurance Data

Net Weight

Production [gram]	233	233	234	228	231
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Residual Gas

Production [cc]	11	11	9	11	14
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Internal Pressure

UGA-Egg Lot 6031	Passed
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2.3.4 Observations and Comments

Product preparation procedures used in these test were scaled up to the equipment capability of the Demo Facility. For the 1/31/06 production process, 57% of the whole egg was added at the beginning of the batching process. This raised the liquid level in the kettle to an minimal height in which the high shear mixer in combination with the scrape surface mixer can blend and disperse the ingredients without incorporating excessive air. Mixing in “Air” into the product is a concern as it can have adverse effect on the quality of the product during thermal processing. A CO₂ blanket was add to the kettle headspace to minimize the effect. However as can be seen the density of the mixed product indicates a fair amount of gas incorporation. This might affect the texture of the product, as it will be fluffier and less rubbery. Controlling the density of the product might require vacuum mixing and/or high shear mixing in a closed loop system. This equipment would need to be acquired or leased if desired.

The water cascade R&D retort at the Demo Site is not a production retort and care needed to be taken to achieve performance that was comparable to commercial spray retorts. Distribution of the heating and cooling media was significantly improved over the retort runs that were performed in October 2004. This was accomplished by adding space in between racks to allow better water flow in between the pouch layer and the addition of a shower head to improve the distribution of the heating media. These changes reduced the capacity of the retort to 180 pouches per retort load.